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COMPREHENSIVE EXAMINATIONS.

BY F. EUGENE SEYMOUR.

The present impetus given to the consideration of comprehensive examinations in our schools had its origin in an address by Superintendent Maxwell, of New York City, delivered before the Association of College and Preparatory Schools of the Middle States and Maryland at their 25th annual convention held at Columbia University, New York City, December, 1911. Many liberal interpretations of this particular phase of the address have been made, but I shall define the question and attempt to discuss it, conforming as closely as possible to what seem to be the intentions of the author.

In our present scheme of education in secondary schools the freshman takes his first-year algebra, at the end of the year submits to an examination and, to use the language of the author, promptly "casts the subject into the limbo of despised and forgotten lore." He then takes his second-year algebra, plane geometry, advanced algebra or trigonometry, in the succeeding year, and each in turn after its completion is destined to the same unfortunate neglect. The panacea suggested for this and other consequent evils resulting from such a piecemeal method of examining is a comprehensive examination which shall cover, in this case, all the mathematics he has studied during the four years he has spent in the high school. The burden of this paper is concerned mainly in discussing whether or not such an examination will meet the purposes we have in the teaching of mathematics.

Every properly conducted recitation reflects the aim and purpose we have in teaching. If this aim be the "acquisition of knowledge" it is reasonable to expect this purpose to be revealed in the kind of questions which are asked; if the ultimate aim is to "develop correct habits of thought," again it is reasonable to expect that class work will reflect that aim. It is equally true that every properly constructed examination should reveal the aim and purpose which we have in giving the particular course

over which the examination extends. It is not to be inferred from this that every statement made in the recitation, or every question which occurs upon the examination should bristle with ultimate aim, but, having listened to the recitation, and having carefully read through the examination, it seems a reasonable requirement that we should be able to find reflected in each the aim and purpose we have in teaching that subject.

If we grant this, then the first question to be decided is: What is our aim in teaching mathematics, and secondly is the comprehensive examination the best and surest test as to whether this purpose has been accomplished.

Society is demanding, as never before, and yet in strict keeping with the times, that the students turned out by the schools as finished products shall be capable as citizens to function for their own good and advancement and for that of the community. No more righteous demand could be made, and having accepted this standard it must be our task as teachers of mathematics to add our mite toward this functioning citizen. What can we accomplish through the medium of mathematics? All else being equal, what advantage do we expect that student who has had a training in mathematics will possess over one who has not? What do we understand to be our aim in teaching mathematics?

With the great majority of pupils the training obtained in the elementary and high schools furnishes their sole preparation for the future; to this period we may usually turn and find the reason for the success or failure which attends them in life. Our stewardship here is a profoundly important one, their destiny is literally in our hands. What can we do toward making them efficient citizens?

When we realize that practically none of the majority whose preparation ends with the high school will have any actual need for the mathematics they learn beyond the 8th grade we see at once that for them our aim can not be to "acquire knowledge." It seems folly to attempt to invent problems of every-day life where they would need or could use the facts of algebra and geometry which they have learned. What they have learned in arithmetic, together with sound common sense, will solve the problems they must necessarily meet. The subject matter in algebra and geometry must therefore be treated as a means to

an end and not as the end itself. The facts we learn in geometry are by-products, they are supposed merely to afford us occasions for bringing out the lesson we wish to teach or the power we wish to create. He will not be adjudged a good teacher of geometry who has succeeded in imprinting indelibly upon the memory the facts of geometry, but rather he who has succeeded in creating, through the medium of geometry, a habit of systematic and logical thinking.

There may be inspired by our teaching what is spoken of as the "joy of mathematics," the contact here with absolute truth may have its ethical value, some of the facts may help us to explain and understand phenomena in other sciences, but commendable and helpful as they are these results must be considered as secondary. They all afford us pleasure and satisfaction as we study, but from their very nature they are passing. They serve their purpose in making more agreeable and unconscious the accomplishment of the real task, creating a power which shall endure long after the subject is forgotten.

A carpenter may have an excellent kit of tools and be thoroughly trained in the use of each individual tool, so that if you give him a board and a plane he can reduce it to the smoothness of glass, or if you give him a mortise guage, a mallet and chisel he will be able to make a perfect mortise joint. We would not let this stand, however, as our test of his ability. We would rather insist that he be able to work out any construction we might suggest, say that of a cabinet, and that he show his ability by the proper selection as well as the masterful use of the tools and materials to be employed.

So the student in mathematics may have an excellent kit of tools and be thoroughly trained in the use of each individual tool so that if he be given an exercise under any special theorem or an example under a special type of factoring he will be able to solve both perfectly. We would not let this stand, however, as our test of his ability. We would rather insist that he be able to take a fact disassociated from any fact he has already studied, and systematically select the proper tools he needs to attain the solution.

I realize there are many other things which it is well for us in our teaching of mathematics to seek to attain, but I believe

they are all secondary to the effort to create this power of systematic working and systematic thinking.

It may be argued that the student can not learn to work systematically unless he has tools with which to work and therefore it is essential that he retain his subject matter. If he is to continue his work in mathematics doubtless this should be true; if he is to enter college, as the scheme now is, it has to be true; and yet what advantage does such a student possess over one who has forgotten his subject matter, save that it qualifies him to continue in the same field. If we are going to decide what good it is doing we must not think of mathematics, but turn to life to find it.

I grant it is essential to retain the subject matter during the period when the student is being disciplined into this systematic way of thinking and working, for we must have a field in which to work. But once the habit is created it has served its purpose and its retention can be justified only on the ground that he intends to dig deeper in the same field of learning.

In presenting thus briefly and imperfectly what I consider should be our first aim in teaching mathematics I have been guided by the service it may render him in the future and not by the pleasure he may derive from it in the present. I think our mission is, not to make his mind a storehouse for knowledge, but rather a factory for creating it, with the world, not books, the place to get his raw material.

Granting this to be our aim in teaching mathematics what shall be the surest and fairest test as to whether we have accomplished our purpose?

The advocates of comprehensive examinations argue that under the present scheme of examining the student passes his first year mathematics and promptly forgets the subject matter; he then passes his second year mathematics and promptly forgets it, and so on for the four years. Might we not reasonably add a final stage: he takes his final comprehensive examination and promptly forgets the whole four years? Are we justified in expecting anything else? Why deny him for four years this blessed privilege of forgetting, unless it be that at the end his joy may be complete? We have forced him to retain his subject matter over a period in which he has no use for it save to con-

tinue further in the same field, and then as he stands on the threshold he bids adieu to it all.

Isn't it a blessing to him that he can cast it into the "limbo of forgotten lore?" If there hasn't anything come out of his work in mathematics which has become a part of his very being, which time itself can not destroy, what lasting impression can we expect after the comprehensive examination? And if we have succeeded during the course in inspiring in him correct habits of work which will serve him in the future, what added gain can come from a comprehensive examination? I think it was Lowell who said he was mighty glad he could forget his Latin, so long as he retained the discipline which resulted from its study. The power which comes from the study of mathematics is a growth and can not be created spontaneously by any comprehensive examination. If the power we are seeking to create has not been attained at the completion of each year's work it would be a travesty to seek it by a single stroke.

Again the advocates of comprehensive examinations denounce our present scheme of examination as a persistent foe to thoroughness. They say that our boys and girls having passed an examination never think and never want to think of that particular subject again. If this were true it would be a paradox, for the students make credible progress in their mathematics in their second and succeeding years, and yet this presupposes the knowledge they have acquired during the previous years. Thoroughness doesn't depend upon how much they forget, but upon the quality of the matter they retain. If thoroughness means retention of everything learned in previous years, I am afraid we must all plead guilty to the charge; but if it means retention of essentials, as we know them from experience, and a growing power in systematic reasoning, then most of us are innocent of the charge.

But this isn't all, we are told that "a high school pupil never reviews except under the direction of the teacher, and therefore seldom, if ever, acquires the power and habit of independent review." "This power and habit of independent review," they continue, "is the best preparation for independent power in attacking a new subject, and," they add, "the comprehensive examination that covers all the mathematics in the school is

the only force that will compel independent review and independent study."

I grant that any scheme which would encourage independent review and independent study on the part of the pupil is a most commendable scheme, but I do not believe we are warranted in expecting this to result from the comprehensive examination. The reputation of the teacher as well as that of the pupil would be at stake and I am sure they would resort to all legitimate means to get "prepared" for such an examination. Just as long as there are examinations, whether they cover a period of four weeks or four years, there will be cramming for those examinations. The only difference I can see between the preparation for examinations as they are now conducted and examinations over a period of four years is a difference of degree: the latter would be nothing less than cramming raised to the fourth power.

I heartily believe in encouraging the power of independent review and of independent study, but this is a power which can not be acquired in a day or in a period of six weeks that may be set aside in which to prepare for comprehensive examination. It must come as a part of our daily work and frequent reviews when its purpose is not overshadowed by an impending and all-important examination. It must be a natural and gradual development, not a means to an end but an end in itself.

Let us assume now for the sake of argument that the comprehensive examinations are desirable, and that they are in vogue in our schools. What shall be our scheme of promotion from one grade to the next? Shall it be our present scheme? If so, what importance shall be attached to our comprehensive examinations? In case the pupil fails in his final examination must he become a freshman again and repeat the work or shall he simply beat time until he succeeds in passing another examination?

Each pupil in his senior year will be carrying at least four subjects. According to this new scheme each pupil during his last year will now be required to submit to an examination covering the work of four years in at least four subjects. It would seem for pupils of this age a physical impossibility.

We are at present complaining of the alarmingly small per

cent. of pupils entering school who remain until graduation, and we are trying to devise ways to encourage them to stay and finish their course. I am sure we can all anticipate the inevitable results which would come when the students realize these all-important examinations at the end of the course were hanging over their heads.

Such a scheme, therefore, if adopted, would require, it seems, a readjustment of the whole curriculum and would unquestionably reduce our already too small per cent. of graduates.

Several interpretations have been given to the question of comprehensive examinations, among them that it be a test of ability to use the facts learned in one subject in the study of other subjects. To do this effectively the pupil must work long enough to correlate the knowledge acquired in the different courses. It is questionable if there is enough concentration in our secondary schools to make this of real value. It might be all right for pupils who concentrate their work on certain subjects but this idea of specializing isn't sufficiently marked until they enter college. Another interpretation of the comprehensive examination is that it be a test of ability to use, in a masterful way, the tools they have acquired in any particular subject as manifested in their power of independent and systematic reasoning in that subject. This variety of opinion as to the proper kind of an examination comes from our uncertain purpose in education. The chief aim in an examination should be to find out whether or not we have accomplished our purpose in teaching the subject. When we have correctly decided what this shall be [but not until then], the character of the right kind of an examination will be determined.

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